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FORAGE CONSUMPTION AS SOILAGE BY HOLSTEIN, NATIVE AND HOLSTEIN-NATIVE CROSSBRED COWS

LUIS RIVERA BRENES[1]

INTRODUCTION

Feeding good-quality roughage to dairy cows is one of the major managerial problems confronted by the dairy industry in the Tropics, especially where the intensive system is used. In Puerto Rico, as in other tropical countries, larger amounts of concentrates have to be fed in order to meet the deficiency of the roughage, thus increasing the cost of milk production. This deters the low-income families from consuming adequate amounts of this essential food.

Duckworth (1)[2], while studying the same problem in Trinidad, stated the following: "The difficulty of providing tropical dairy cows with an adequate supply of green herbage of good nutritive value is widely recognized as being one of the main obstacles in the economic production of milk in many parts of the tropics." He also observed that "the degree of supplementary feeding was much greater than would have been expected from the difference in roughage consumption." In a herd whose average weight was 825 pounds, with an average production of 14 pounds of milk, he found that the average consumption of freshly chopped Elephant grass was 51 pounds per head daily, which is approximately, 10.1 pounds of dry matter. This was equivalent to about 6.2 pounds of grass or 1.22 pounds of dry matter per 100 pounds of live weight. In Hawaii (3) the average consumption of chopped Napier grass for a group of cows averaging in weight 996 pounds was 54.2 pounds or an average of 5.44 pounds per 100 pounds of live weight. Harrison (2), in his digestibility trials with European and Zebu cattle, found that animals under trial consumed an average of 1.6 pounds of dry matter per 100 pounds live weight. Morrison (5), in his feeding recommendations, states that the amount of silage fed per head daily to dairy cows usually ranges from 20 to 40 pounds per 1,000 pounds of live weight. When cows are fed twice a day all the silage and good legume

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[2] Numbers in parentheses refer to Literature Cited p. 96-7.

hay that they can consume, amounts of about 3 pounds of silage and 1 pound of hay per 100 pounds of live weight, in addition to the usual amount of concentrate mixture are fed. Cows given silage as the only roughage, will eat as much as 6 pounds of silage daily per 100 pounds of live weight. In experiments carried out in New Jersey (7), cows receiving grass silage as the only roughage lost weight, but the milk production was maintained, thus indicating that the roughage alone was not sufficient for both maintenance and production. It was found impossible to maintain the intake of grass silage or grass silage and corn silage at the calculated intake levels. In Minnesota (8), researchers had the same difficulty in getting the cows to consume enough silage. Milk production declined during silage periods when compared to hay periods.

This study was undertaken in order to determine the daily roughage (soilage) intake and also to compare the Holstein, Native, and Holstein-Native crossbreds feeding under conditions of the Island. For the purpose of the experiment the crossbreds will be called a breed. All animals used for the experiments were selected from the Station's herd.

SOURCE OF DATA

Six groups of cows totaling 59 animals were used. Each group included the three breeds mentioned above. The experimental periods were of 18 to 81 days, during October 1947 to August 1949. Almost all the cows were included in more than one experimental period. Because of this, the number of experimental days varied from 22 to 269 days.

The forage used was Merker grass (*Pennisetum purpureum* var. Merkerii), a strain of Elephant grass. The quality of the grass fed was comparable to that of the grass commonly fed in local dairies under the intensive system in the Island, that is, grass 80 or more days old, quite mature. Young grass was used only for a very few days, due to transportation difficulties.

The grass was brought from the field and chopped in a silage chopper. Trial cows were fed in the morning and the afternoon. The roughage given, which was more than sufficient, as well as the left-overs, was carefully weighed daily for each animal.

Cows were weighed for three consecutive days: at the beginning and at the end of each experimental period, and once a week during the experimental periods.

Chemical analyses of the roughage samples were made according to A.O.A.C. official methods. The number of samples taken for analysis varied from 2 to 6 depending on the length of the experimental period. A total of 21 samples were analyzed.

RESULTS AND DISCUSSION

Dry-matter and crude-protein contents, together with the digestion coefficient for protein and total digestible nutrients for Merker grass, are given in table 1. The digestion coefficient and TDN figures were taken from unpublished data from digestion trials with the same kind of roughage previously performed at this Station.

The averages by breeds of the data studied are presented in table 2.

Neither the differences in the amount of roughage and dry matter consumed per hundred pounds live weight between breeds nor the regressions

TABLE 1.—*Dry matter, crude protein, digestion coefficient for protein and total digestible nutrients for Merker grass (dry basis)*

Samples	Dry matter	Crude protein	Digestion coefficient for protein	Total digestible nutrients
Number	*Percent*	*Percent*		*Percent*
21	25.52	5.07	52.4	50.00

TABLE 2.—*Average weight, roughage, and dry-matter consumption, digestible protein, and TDN per group*

Breed	Cows	Average weight	Soilage eaten daily	Soilage per 100 pounds live weight	Dry matter per 100 pounds live weight	Daily intake of digestible protein	Daily intake of TDN
	Number	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Holstein	10	962	66.60	6.92	1.76	0.4515	8.49
Grades	30	832	59.45	7.14	1.82	.4031	7.58
Natives	19	783	64.84	8.28	2.11	.4397	8.27

of the amount of roughage on weight of animal within breeds were significant. The difference between the daily intakes of digestible proteins and total digestible nutrients were not significant, either.

In studying the data it was observed that the smaller cows ate somewhat more roughage per 100 pounds of live weight. This trend of relation between weight and roughage consumption was studied, but the regression was not significant.

Although a little higher, the roughage consumption of the Holstein group (table 2) agrees with the findings of Henke in Hawaii (3) with chopped Napier grass. The difference may be attributed to a difference in palatability as Merker grass is not as thick and hard-stemmed as Napier.

In table 3 the maintenance requirements of digestible proteins and

total digestible nutrients (5) for adult cows within which the average weights for our animals fall are presented.

As shown by the above figures the group of Native cows was the only one almost getting the necessary amount of protein; the Holstein and the crossbreds were on the deficient side, but all three groups received enough total digestible nutrients for maintenance. Results in table 2 show that the smaller animals were getting the largest relative amount of dry matter, equivalent to larger amounts of digestible proteins and total digestible nutrients. This might be an important fact to consider in breeding dairy cattle for the tropics.

The amount of dry matter intake is important, but the quality of the same is still more important in the nutrition of dairy cows. Harrison (2) considered 1.6 pounds low-intake of dry matter per 100 pounds of live weight. The fodders used were too high in moisture and the animals were

TABLE 3.—*Digestible-protein and TDN requirements for maintenance of adult cows of 700 and 1,000 pounds live weight*

Weight of cows	Digestible protein	TDN
Pounds	*Pounds*	*Pounds*
700	0.45	6.00
1000	.60	8.00

unable to eat enough bulk to obtain all the required dry matter. In spite of being low, the dry-matter intake reported was enough for maintenance. Wilting of the grass was recommended, so that the animals could consume larger amounts of dry matter. Hay materially increases the dry-matter intake, but in regions where weather makes the curing of hay difficult or impossible, soilage or silage must be fed as source of roughage, when cows are not on pasture. Because of the intrinsic characteristics of the grass soilage itself, it is difficult to increase the daily dry-matter intake to a point where a minimum amount of concentrates has to be supplemented; this is especially true for big cows like the Holsteins. Otherwise, the amount of nutrient intake from the roughage can be materially improved and increased by the use of legumes, either alone or in combination with grasses.

Table 4 shows the nutrient intake of a 700-pound cow consuming the kind of roughage described in this report and also consuming a good quality legume-grass mixture like Merker-Kudzu. It also indicates the amount of concentrate supplement needed to produce 25 pounds of 4-percent-fat milk.

When consuming the lower quality roughage this cow will need 9 pounds of the usual commercial 20-percent-protein dairy feed (17.7 percent of the

protein being digestible and 76.1 percent TDN) to meet the deficiency of the roughage for maintenance and to produce the 25 pounds of milk. This same cow consuming the higher quality roughage will need only around 8 pounds of a 14-percent-protein concentrate, (assuming the same digestibility of the protein and TDN as for the 20 percent). This 14-percent-protein feed could be a mixture of Island-produced ingredients like yeast, molasses, bagasse, corn, coconut meal, etc. plus salt and minerals. Another important fact to consider when a good-quality roughage is fed is that of palatability.

TABLE 4.—*Comparisons between the requirement and consumption of nutrients by 700-pound cows producing 25 pounds of 4-percent-fat milk and consuming poor and good quality roughages*

Weight of cow	Maintenance		Production		Total	
	Digestible protein	TDN	Digestible protein	TDN	Digestible protein	TDN
Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
700	0.45	6.00	1.12	8.00	1.57	14.00

NUTRIENT INTAKE WHEN CONSUMING POOR QUALITY ROUGHAGE

Roughage consumed per 100 pounds of live weight	Total roughage consumed	Crude protein	Digestible protein consumed	TDN consumed
Pounds	*Pounds*	*Percent*	*Pounds*	*Pounds*
8	56	5.07	0.38	7.14

NUTRIENT INTAKE WHEN CONSUMING GOOD LEGUME-GRASS ROUGHAGE

Pounds	*Pounds*	*Percent*	*Pounds*	*Pounds*
8	56	10.0	0.75	8.00[1]

[1] Assuming 55 percent TDN.

If the dry-matter intake is increased upon a larger consumption, the amount of supplemental feed needed can be reduced considerably.

Ordinarily, both Merker and Para grasses (the latter is another of the common soilage grasses used) are low in protein and higher in fiber, when fertilizers are applied immediately after cutting, and when cut from 80 to 100 days old. The crude-protein percentage is usually not higher than 5, dry basis. Tropical Kudzu has been planted for some years in this Station together with Merker or Para grass, but especially with the latter. This legume nearly always has more than 17 percent of crude protein on the dry basis, and when planted together with the grass the mixture has a crude

protein content of 10 percent or more, depending on the amount of Kudzu included in the mixture.

Although, as stated by Huffman (4) "it is generally recognized that the total digestible nutrients (TDN) that cattle receive from an all roughage ration are not as efficient for milk production as when roughage is supplemented with concentrate," it is true that when good-quality roughage is being fed, the amount of concentrate supplement needed to meet the requirements for production can be reduced, thus lowering the cost of milk production. For the type of high-milk-producing cow developed, concentrates are needed to supplement the roughage ration and still more so now that their milk-stimulating effects are known (4).

SUMMARY AND CONCLUSIONS

A study was undertaken to determine the daily roughage (soilage) intake of the Holstein, Native, and Holstein-Native crossbred cows of the Station's herd and to check on probable differences between them.

The apparent consumption of the largest amounts of soilage or dry matter per hundred pounds of live-weight by the Native cows, 8.29 pounds soilage and 2.11 pounds dry matter, as against 7.14 and 1.82 pounds respectively for the crossbreds; and 6.92 and 1.76 pounds respectively, for the Holsteins, was found to be not significant. Neither were the regressions of the amounts of roughage consumed on weight of animal significant within breeds.

The kind of roughage usually fed as soilage to dairy cows in the Tropics makes it difficult to increase consumption over the amounts shown above, but the quality of the same can be improved by the use of legumes. This will increase the amount of digestible nutrients ingested which will compensate, in part, for the reduced dry-matter intake.

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AN IMPROVED TECHNIQUE FOR THE MICROSCOPIC DIAGNOSIS OF LIVER-FLUKE INFECTION IN CATTLE

JOSÉ D. RIVERA ANAYA AND JOSÉ MARTÍNEZ DE JESÚS[1]

The diagnosis of internal parasitism in livestock is of unquestionable importance both in veterinary research and routine work. The finding and identification of parasitic ova in feces in microscopic examination helps to establish a definite diagnosis in the case under consideration.

The common liver fluke (*Fasciola hepatica*) is an important enzootic parasite of cattle in Puerto Rico. Identification of the fluke ovum is relatively easy, as it has a characteristic shape and size and a single polar operculum. Because fluke ova are not suitable for flotation in solutions of high specific gravity in which they collapse and become distorted, and because clumps of fecal particles mask the ova and make their observation and identification difficult, different techniques were studied trying to obviate these problems.

The method for fluke-ova identification as used by Oliver (1)[2] requires very little equipment and is simple in procedure. However, in pouring off the supernatant fluid, the sediment in the conical sedimentation glass is disturbed and there is the risk of throwing away part or all of the fluke eggs present, thus making the diagnosis of fascioliasis very difficult.

Swanson and Hopper (2) have worked out a reliable technique for the quantitative examination of fasciola-eggs. However, it takes time, and several pieces of laboratory equipment are necessary.

To obviate some of these handicaps an improvement to this method (Swanson and Hopper) has been devised, in which several steps are omitted and the rate of sedimentation is increased.

The procedure is as follows:

1—Collect a gross sample of 500 gm. of feces from the rectum.

2—Place the sample in a 1,000-ml. beaker and mix thoroughly.

3—Take a 5-gm. sample (by taking small amounts from various parts of the gross sample); put it into a 250-ml. Erlenmeyer flask. Add 100 ml. of tap water and shake until a uniform suspension is obtained.

4—Wash the sample through a series of wire-screens (20-, 40-, and 60-mesh) into a 1,000-ml. beaker, and transfer the suspension to a graduated glass cylinder, 1,000 ml. volume.

5—Add 1 ml. of a 1-percent solution of aluminum sulfate to the fecal suspension and stir thoroughly. Let the mixture settle for 10 to 15 min-

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[2] Numerals in parentheses refer to Literature Cited p. 99.

utes. Siphon off the supernatant fluid to about three-fourths of an inch from the bottom by using a bent glass tube without disturbing the ova-containing sediment. One end of a glass tube of a one-eighth-inch bore and about 12 inches in length is bent over a burner flame in a three-fourths inch **U** shape. To siphon the supernatant fluid off, connect the long straight end of the glass tube to a vacuum filter pump with a piece of rubber tubing.

6—Add 1 ml. of standard tincture of iodine to the sediment; agitate to mix thoroughly, and let stand for 2 minutes. The tincture of iodine stains the fluke egg a deep brown color, making its identification easy.

7—Pour the sediment into a 15-cc. centrifuge tube; centrifuge for 2 minutes at about 2,000 r.p.m.

8—Pour off all the supernatant fluid except 1 ml. This is left in so as to mix with the sediment and make it watery. Besides, the risk of pouring off fluke eggs is avoided by leaving this 1 ml. of fluid on top of the sediment.

9—Mix the sediment well with a wooden applicator and transfer some onto a clean glass slide by using the applicator.

10—Put a cover glass over the specimen and examine under the low and high powers of a microscope.

The advantages of this procedure in the diagnosis of liver-fluke infestation through a fecal examination and microscopical identification of the ova, as compared to the method of Swanson and Hopper (2) are:

1—Several steps and the use of some pieces of laboratory equipment are eliminated.

2—The time required for the examination is greatly reduced, as the sedimentation takes only 10 to 15 minutes after adding 1 ml. of a 1-percent solution of aluminum sulfate.

3—The addition of 1 ml. of a 1-percent solution of aluminum sulfate, besides greatly shortening the time needed for sedimentation, does not exert any deleterious effect upon the shape of the fluke egg, hence does not interfere with the identification of liver-fluke ova.

4—The use of standard 7-percent tincture of iodine eliminates the preparation of special 15-percent tincture.

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INFLUENCE OF TIME OF HATCHING ON SEXUAL MATURITY OF PULLETS IN PUERTO RICO

A. GONZÁLEZ-CHAPEL AND M. ROJAS DAPORTA[1]

INTRODUCTION

The problem of the adaptability of livestock and poultry breeds to tropical climates has been of considerable interest to many workers in the last few years. A re-examination, under tropical conditions, of fundamental facts already ascertained in temperate climates, appears to be necessary for a better understanding of the problem.

Sexual maturity is considered as one of the three most important heritable factors determining egg production. By sexual maturity is meant the number of days between the date a pullet is hatched and the date she lays her first egg. Date of hatch is probably the most important nongenetic factor affecting sexual maturity. Rice, Hall, and Marble (5), concluded:

> The distribution of eggs and also the total annual production in the first laying year of an individual or a flock is influenced greatly by the time of the year that the individual or flock is hatched. The effect of early or late hatching is undoubtedly greater in the first laying year than it is in the later laying years. The influence of time of hatching no doubt is due primarily to the environmental conditions as affecting rearing and subsequent production. Frequently the unfavorable conditions may be overcome so that the time of hatching becomes an unimportant factor. In those sections of the country where the widest extremes of seasons occur, the influence of time of hatching is greatest, and on the other hand in those regions having the most uniform and favorable climatic conditions there is much less difference.

Knowledge of the kind and extent of the influence of time of hatching on the sexual maturity of pullets in Puerto Rico is necessary for the proper evaluation of the environmental factors affecting egg production in the tropics.

REVIEW OF LITERATURE

Ample research has been done in the United States on the subjects of time of hatching, date of first egg, sexual maturity, and egg production.

The correlation between sexual maturity and egg production has been very definitely demonstrated by many workers. According to Rice, Hall, and Marble (5), three different experiment stations, Massachusetts, Missouri, and Cornell, reporting on the relationship between sexual maturity and egg production based on the records of 2,846 birds, covering a period of ten years, presented very significant correlations between sexual maturity

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and annual egg production. This means that under normal conditions the less the number of days to date of first egg the greater will be the number of eggs laid in one year. Birds maturing extremely early are less desirable because of the small body size and egg size.

Jull (2), details a number of investigators which have shown that the time of the year that a pullet commences laying is important from the standpoint of the total number and value of eggs laid during the first laying year.

Rice, Hall, and Marble (5), reported the following data from the Oklahoma A. and M. College on the relationship of time of hatching and sexual maturity:

Season hatched	*Days to first egg*
Early Winter	156.4
Late Winter	185.3
Early Spring	236.3
Late Spring	233.7
Early Summer	229.3
Late Summer	214.3
Early Fall	195.5
Late Fall	178.6

Jull (2), states that in order to be able to compare the egg records of dams and daughters or of sisters, they should be hatched at relatively the same time each year because time of hatch influences egg production. In Puerto Rico, González Chapel (1), concluded that allowance for the date of hatching, as a factor influencing egg production, sexual maturity, egg weight, and body weight at the end of the first month of age, should be made when planning comparisons between breeds.

Knox, (4), in Iowa, studied the relationship between date of hatch and annual egg production in White Leghorns which were hatched from February 8 to June 8, inclusive and found that the best egg production was obtained from the birds which were hatched from the latter part of March to the latter part of May.

Knox (3), in a study of the influence of the date of first egg upon maturity and production, concluded that the time that the first egg was laid had a curvilinear association with winter egg production; that there was a slight curvilinear association between the date of first egg and the rate of spring egg production; and that the records showed a curvilinear association between the date of first egg and total or annual egg production.

PROCEDURE

This study includes data collected during four years, from 1946 to 1949. Sexual maturity was recorded on a total of 1372 pullets of the New Hampshire, White Leghorn, Native, and crossbreds.

The New Hampshires and White Leghorns came from stock originally imported from the United States in 1940. The crossbreds included lines developed from original crosses of New Hampshires x Natives; re-Line 1, Line 5; and White Leghorn x Natives; re-Line 3, Line 6.

In 1946 the data included 307 birds which were distributed as follows: New Hampshire, 144; White Leghorn, 103; and Natives, 60. In 1947 information was collected on 478 birds as follows: New Hampshire, 188; White Leghorn, 78; Natives, 49; Line 6, 104; Line 3, 25; and Line 1, 34. The data in 1948 came from 266 birds of the following breeds: New Hampshire, 139; Line 3, 33; Line 1, 48; and Line 5, 46. In 1949 the data included 321 birds as follows: New Hampshire, 212; Line 3, 61; and Line 1, 48.

The hatching season started on January 16 on each of the four years. The first hatch came on February 6 and subsequent hatches came at weekly intervals after that date. In 1946, 1948 and 1949 the hatches extended from February 6 to June 5. In 1947 they extended from February 6 to April 2 with the exception of Line 1 chicks which were hatched up to May 21.

The eggs from all breeds and crossbreds were hatched in the same incubator; the same feed was given all the birds; they were reared in the same brooder houses and the same men took care of all the breeds.

Sexual maturity was measured as the age in days of the bird at first egg.

Previous work by González Chapel (1), had shown significant differences in sexual maturity between the purebreds and the Natives. For that reason all data was treated separately by breeds and by years.

The statistical analyses of the data reported here was mainly concerned with the evaluation of the effect of time of hatching on the sexual maturity of the pullets and the description of the regression of sexual maturity on time of hatching.

RESULTS

A preliminary analysis of the data showed that time of hatching had a negligible effect on the sexual maturity of 4 out of the 16 groups of birds considered. This was true in 1947, with the 49 Native pullets and the 104 Line 6 pullets; in 1948 with the 46 Line 5 pullets and in 1949 with the 48 Line 1 pullets. These four groups were, accordingly, not further considered in the analysis.

The differences in sexual maturity of the birds due to time of hatching were statistically significant in the other 12 groups.

Table 1 shows the mean sexual maturity of all breeds in each year studied.

In table 2 the mean sexual maturity by hatches during 1946 is presented.

Figures 1, 2, and 3 shows the regression of sexual maturity on time of

hatching for the New Hampshires, White Leghorns and Natives, respectively, during 1946.

TABLE 1.—*Mean sexual maturity in days by breeds and by years*

Breed	Year			
	1946	1947	1948	1949
New Hampshire	225.6	220.5	234.6	234.7
White Leghorn	200.1	196.0	—	—
Natives	231.4	*185.8*	—	—
Line 1	—	218.6	*235.4*	235.4
Line 3	—	183.9	246.6	244.8
Line 5	—	—	*241.4*	—
Line 6	—	*216.6*	—	—

TABLE 2.—*Mean sexual maturity in days by hatches in 1946*

Time of Hatch	Breeds		
	New Hampshires	White Leghorns	Natives
February 6	—	—	—
February 13	186.3	175.9	179.0
February 20	184.5	171.5	185.5
February 27	—	—	—
March 6	201.0	205.4	—
March 13	211.8	216.7	212.3
March 20	203.2	197.7	288.5
March 27	190.3	191.2	287.0
April 3	215.8	210.3	249.2
April 10	232.0	188.9	242.3
April 17	237.4	185.8	240.5
April 24	243.1	204.0	238.8
May 1	—	—	—
May 8	263.7	194.7	249.7
May 15	244.3	224.5	228.3
May 22	251.5	227.2	219.3
May 29	245.6	218.0	177.8
June 5	263.0	209.8	187.5

In the graph, each dot represents one pullet.

The three breeds were differently affected by the time of hatching. From February 6 to March 27 the regression was similar for the three breeds;

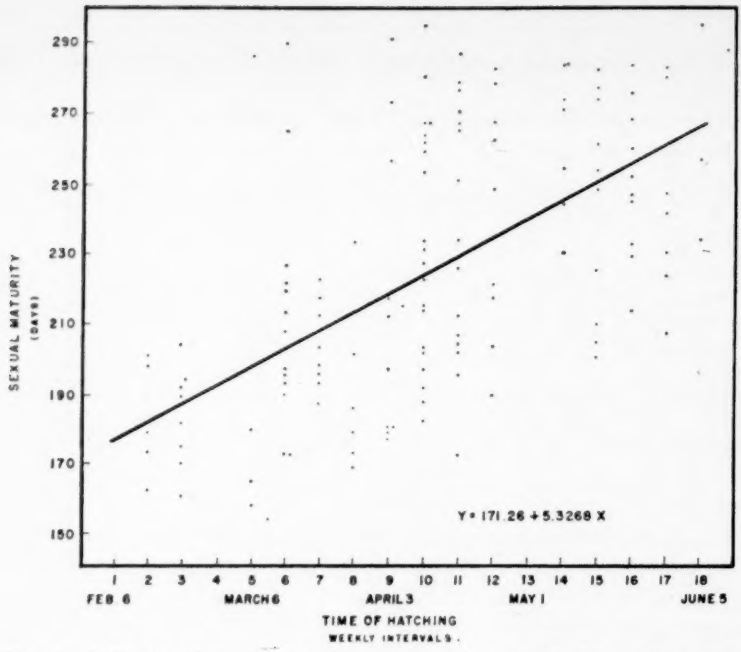

FIG. 1.—Influence of time of hatching on sexual maturity (New Hampshires—1946)

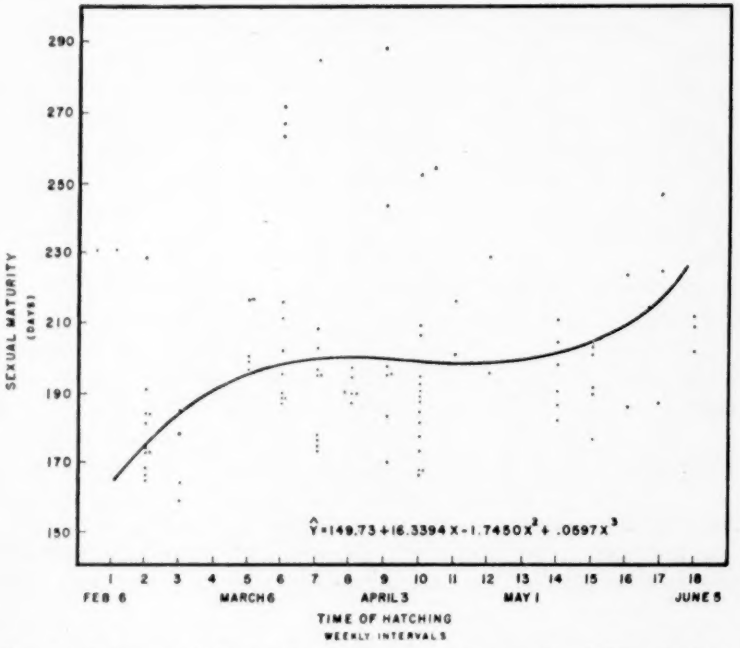

FIG. 2.—Influence of time of hatching on sexual maturity (White Leghorns—1946)

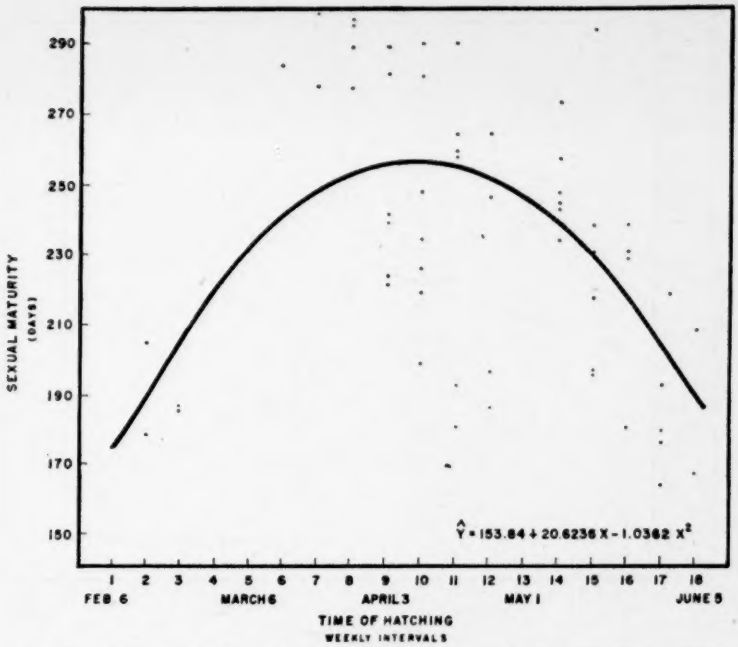

FIG. 3.—Influence of time of hatching on sexual maturity (Natives—1946)

TABLE 3.—*Mean sexual maturity in days by hatches in 1947*

Time of Hatch	Breeds			
	New Hampshires	White Leghorns	Line 3	Line 1
February 6	205.0	176.0	—	—
February 13	203.3	188.2	184.0	175.0
February 20	221.2	196.4	177.0	—
February 27	222.3	195.6	181.3	173.7
March 6	202.7	189.4	161.0	202.5
March 13	218.9	183.6	180.3	—
March 20	216.2	188.6	167.0	184.7
March 27	237.4	201.0	—	—
April 3	228.6	223.3	—	222.0
April 10	—	—	217.6	242.0
April 17	—	—	—	224.0
April 24	—	—	—	252.2
May 1	—	—	—	233.3
May 8	—	—	—	—
May 15	—	—	—	214.8
May 22	—	—	—	219.5
May 29	—	—	—	—
June 5	—	—	—	—

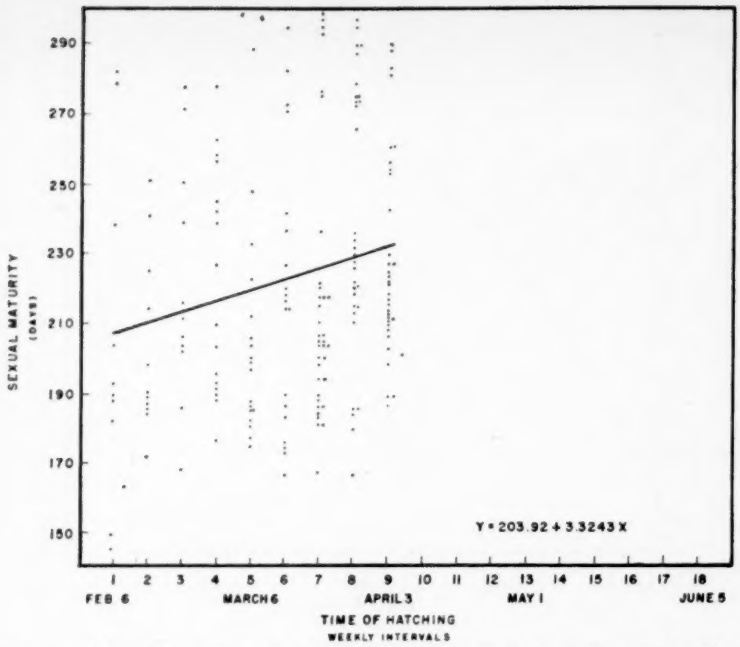

FIG. 4.—Influence of time of hatching on sexual maturity (New Hampshires—1947)

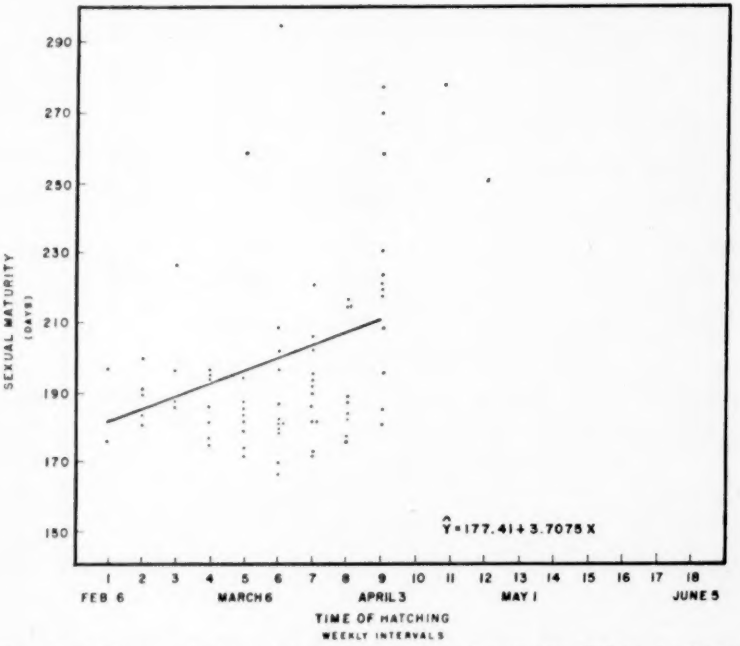

FIG. 5.—Influence of time of hatching on sexual maturity (White Leghorns—1947)

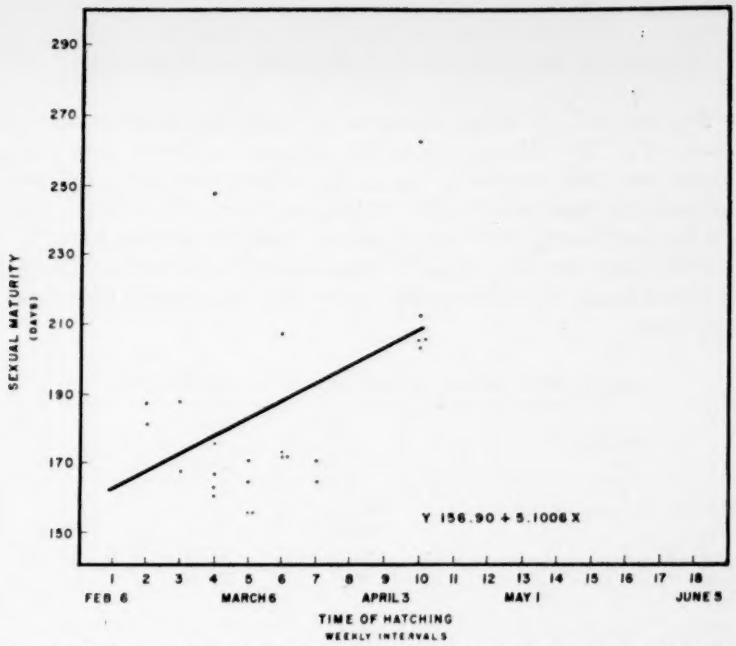

FIG. 6.—Influence of time of hatching on sexual maturity (Line 3—1947 (W.L. x Nat.))

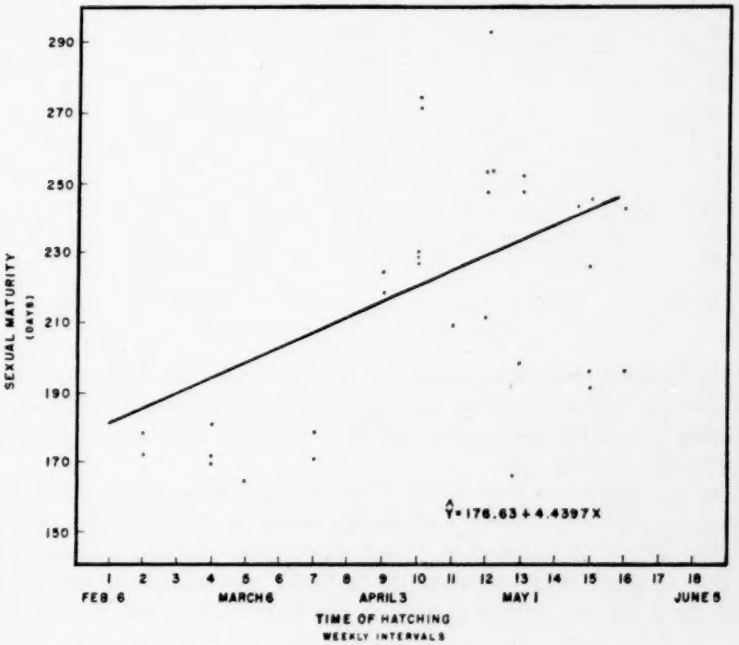

FIG. 7.—Influence of time of hatching on sexual maturity (Line 1—1947 (N.H. x Nat.))

the pullets hatched in February being earlier maturing than those hatched in March. The New Hampshire pullets hatched in March were earlier maturing than those hatched in April; the pullets hatched in April were earlier maturing than those hatched in May and June. The White Leghorn pullets hatched during April were similar in maturity to those hatched at the end of March but after April 23 those hatched earlier matured earlier. On the other hand, the Native pullets, after April 10, matured earlier when hatched later.

TABLE 4.—*Mean sexual maturity in days by hatches in 1948*

Time of Hatch	Breeds		
	New Hampshire	Line 3	Line 1
February 6	238.8	—	—
February 13	205.6	—	181.7
February 20	217.2	217.8	204.5
February 27	240.4	233.0	242.8
March 6	230.4	—	245.5
March 13	255.3	60.0	227.3
March 20	259.5	289.0	63.3
March 27	231.8	261.8	—
April 3	232.1	243.5	249.0
April 10	244.4	283.3	256.5
April 17	233.4	—	236.7
April 24	245.4	—	262.0
May 1	234.2	225.0	—
May 8	265.3	239.0	268.2
May 15	218.6	202.5	195.3
May 22	254.9	251.0	208.3
May 29	200.6	—	198.5
June 5	241.0	221.5	269.5

In table 3 the mean sexual maturity by hatches during 1947 is shown.

Figures 4, 5, 6 and 7 shows the regression of sexual maturity on time of hatching for the New Hampshires, White Leghorns, Line 3's and Line 1's, respectively, during 1947.

The regression was very similar for the four breeds during 1947. The pullets hatched in February were earlier maturing than those hatched in March, and those hatched in March were earlier maturing than those hatched in April. The regression in the Line 1 pullets, which were tested after April 10, was similar to that of the New Hampshires in 1946; the

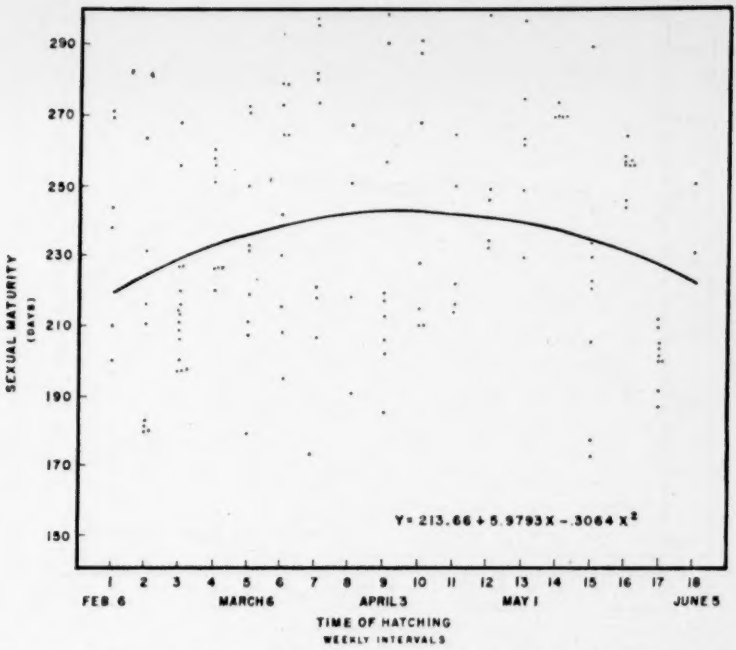

FIG. 8.—Influence of time of hatching on sexual maturity (New Hampshires—1948)

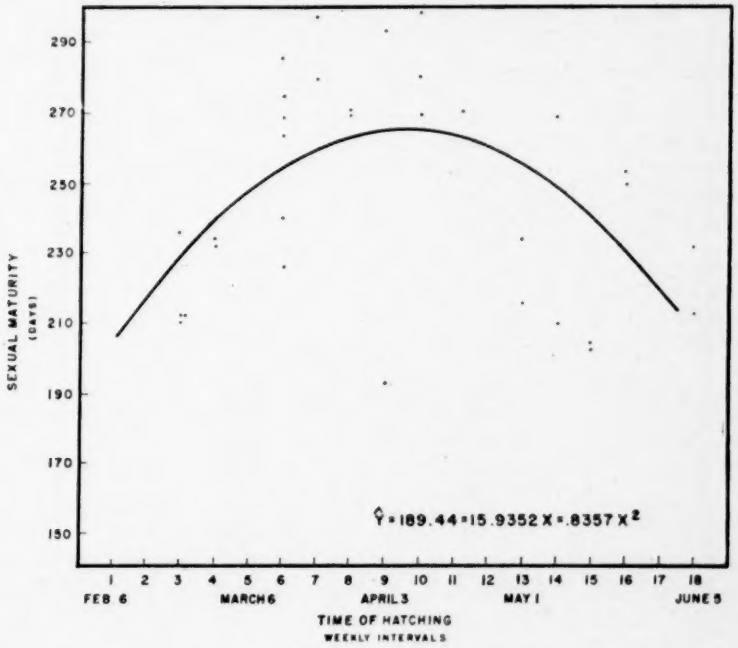

FIG. 9.—Influence of time of hatching on sexual maturity (Line 3—1948 (W.L. x Nat.))

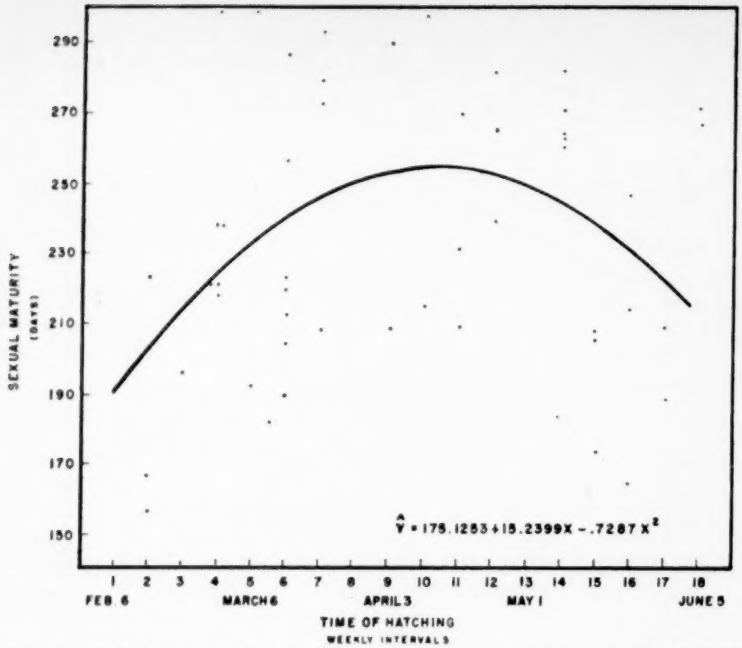

FIG. 10.—Influence of time of hatching on sexual maturity (Line 1—1948 (N.H. x Nat.))

TABLE 5.—*Mean sexual maturity in days by hatches in 1949*

Time of Hatch	Breeds	
	New Hampshires	Line 3
February 6	—	—
February 13	195.3	—
February 20	181.3	261.5
February 27	207.4	211.0
March 6	234.4	201.7
March 13	224.2	234.0
March 20	199.7	231.3
March 27	260.8	276.3
April 3	234.5	253.3
April 10	263.7	269.9
April 17	245.5	—
April 24	230.5	244.5
May 1	241.8	245.2
May 8	212.9	—
May 15	237.7	229.6
May 22	243.4	228.8
May 29	—	—
June 5	—	—

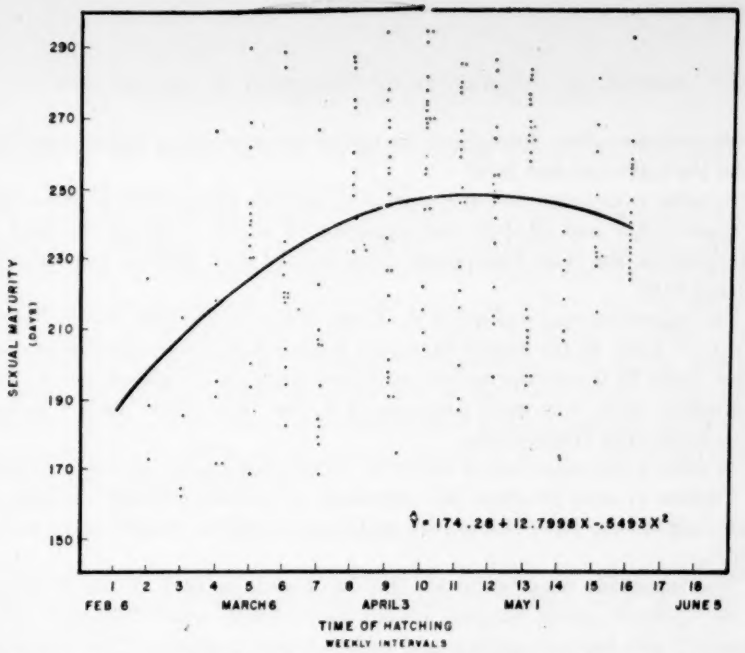

FIG. 11.—Influence of time of hatching on sexual maturity (New Hampshires—1949)

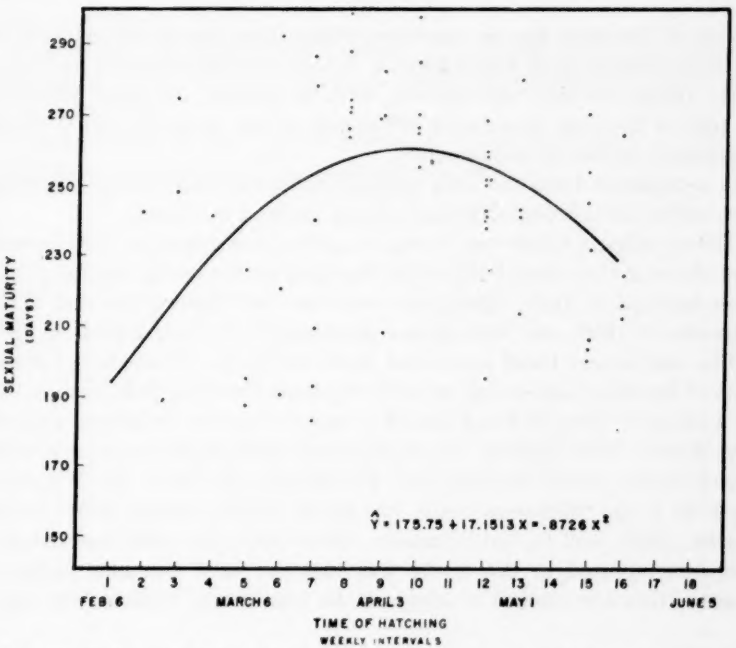

FIG. 12.—Influence of time of hatching on sexual maturity (Line 3—1949 (W.L. x Nat.))

birds hatched earlier throughout the hatching season being earlier maturing than the birds hatched later.

In table 4 the mean sexual maturity by hatches during 1948 is presented.

Figures 8, 9 and 10 show the regression of sexual maturity on time of hatching for the New Hampshire, Line 3 and Line 1 pullets, respectively, during 1948.

The regression was similar for the three breeds during 1948. From February 6 to April 10 the earlier maturing pullets were those hatched earlier; after April 10 the earlier maturing pullets were those hatched latest. The regression curve was more pronounced in the Line 3 and Line 1 pullets than in the New Hampshires.

In table 5 the mean sexual maturity by hatches during 1949 is presented.

Figures 11 and 12 show the regression of sexual maturity on time of hatching for the New Hampshire and Line 3 pullets, respectively, during 1949.

The regression was similar for the two breeds in 1949. From February 6 to April 10 earlier hatched pullets had earlier sexual maturity. After April 17 late hatched pullets had earlier sexual maturity. The regression curve was more pronounced in Line 3 birds than in New Hampshires.

CONCLUSIONS

Time of hatching has an important effect upon the sexual maturity of pullets in Puerto Rico. Regardless of the fact that the climatic conditions in the Island are relatively uniform, with no seasonal extremes, allowance for time of hatching, as a factor influencing sexual maturity and thus, egg production, should always be made.

It is apparent from the data studied that pullets hatched in February have earlier sexual maturity than pullets hatched in March.

The curvilinear trend was strong in most of the groups of birds considered showing that birds hatched in May had earlier sexual maturity than those hatched in April. Exceptions were the New Hampshires and White Leghorns in 1946, and, though less pronounced, the Line 1 birds in 1947.

This curvilinear trend somewhat conforms to the relationship between time of hatching and sexual maturity reported from the Oklahoma A. and M. College in Rice, Hall and Marble's book (5). In the Oklahoma data the late Winter, early Spring, late Spring, and early Summer periods corresponds to the periods studied here. The sexual maturity in late Winter, as reported in the Oklahoma study, was 185.3; in early Spring, 236.3; in late Spring, 233.7; and in early Summer, 229.3. The only difference found in the data reported in this study was that the early Summer pullets in Puerto Rico were almost as early as the late Winter pullets. The curvi-

linearity of the regression was, in most groups, much more pronounced than that reported in the Oklahoma data.

No attempt can be made as yet to explain the cause of the influence of the time of hatching on the sexual maturity of the pullets in Puerto Rico. Further studies are necessary, relative to the environmental and/or physiological factors which may be contributing to the effect. Environmental factors, such as temperature, rainfall, humidity, length of day light and their effect on the rearing and subsequent production of the pullets, should be evaluated, and correlated with the time of hatching to seek a possible relationship. The curvilinear trend suggests that molting could be a possible explanation for the influence of time of hatching on the sexual maturity of the pullets, as reported here.

SUMMARY

This study included the sexual maturity of 1,372 pullets of different breeds and crossbreds hatched from February 6 to June 5 in 1946, 1947, 1948 and 1949.

Time of hatching was found to exert an important influence on the sexual maturity of pullets in Puerto Rico.

Pullets hatched in February had earlier sexual maturity than pullets hatched in March.

In most of the groups of birds studied, a curvilinear trend was apparent showing that birds hatched in May had earlier sexual maturity than those hatched in April.

A series of graphs showing the regression of sexual maturity on time of hatching, by breeds and by years, are presented.